

UNIVERSITY EXAMINATION 2017/2018
YEAR III SEMESTER II EXAMINATION FOR THE DEGREE OF BACHELOR OF
SCIENCE IN INFORMATION TECHNOLOGY
ICS 2311: COMPUTER GRAPHICS

TIME: 2HRS

.....
INSTRUCTIONS

*Answer **Question One** and any other **two** questions*

Question One: (30 Marks)

- a) Outline any four independent components of the OpenGL lighting model. (2mks)
- b) The standard interactive graphics device today is called a raster display. Draw a well labelled diagram to illustrate how a simple raster graphics system works. (4mks)
- c) A display processor relieves the computer's main processor from much of the mundane repetitive effort involved in maintaining the frame buffer. Explain any three operations carried out by a display processor. (3mks)
- d) Computer graphics really comes to life when we draw images that move. Using the glutSwapBuffers () function to ensure smooth animation, write a complete OpenGL program that renders a rotating wire cube on the screen. (12mks)
- e) Explain the general syntax for rendering both a solid and a wire sphere centered at the modelling coordinate's origin of a specified radius and subdivided around the Z axis into slices and along the Z axis into stacks. (4mks)
- f) Write a program that uses a call back function to render a grey window of size 500 by 500 positioned at the center of the screen. (5mks)

Question Two: (20 marks)

- a) Animation adds to graphics the dimension of time which vastly increases the amount of information to be transmitted.
 - i. Differentiate between computer assisted and computer-generated animations. (2marks)
 - ii. In the architecture of raster displays, the pixel data is stored in the frame buffer, which is repeatedly read by the digital-to-analogue converter (DAC) to control the intensity of the electron beam as it sweeps across the screen, one scan-line at a time. Using a well labelled diagram explain why double buffering is required in this type of displays. (5mks)

- iii. `glutSwapBuffers ()` function is important in rendering animated graphics in OpenGL. Briefly explain its function. (3mks)

- b) A key feature of the design of OpenGL is the separation of interaction (input and windowing functions) from rendering. Briefly explain the two libraries that are used to extend the low-level functionality of OpenGL.

- c) Explain the purpose of each of the following OpenGL functions.
 - i) `glutInit (&argc, argv);`
 - ii) `glutInitWindowSize ();`

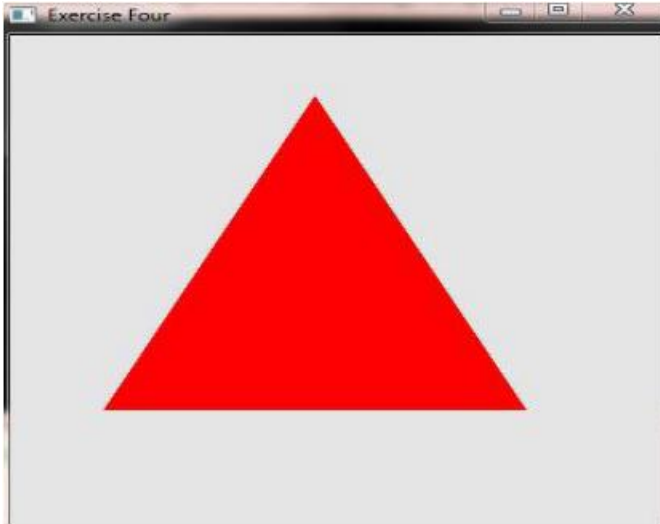
- d) Indicate the OpenGL type definition for each of the following data types. (2mks)
 - i. 8-bit integer
 - ii. 32-bit integer
 - iii. 16-bit unsigned integer
 - iv. 64-bit floating-point

Question Three: (20 marks)

- a) Using a well labelled diagram, explain how a refresh CRT display works. (6mks)

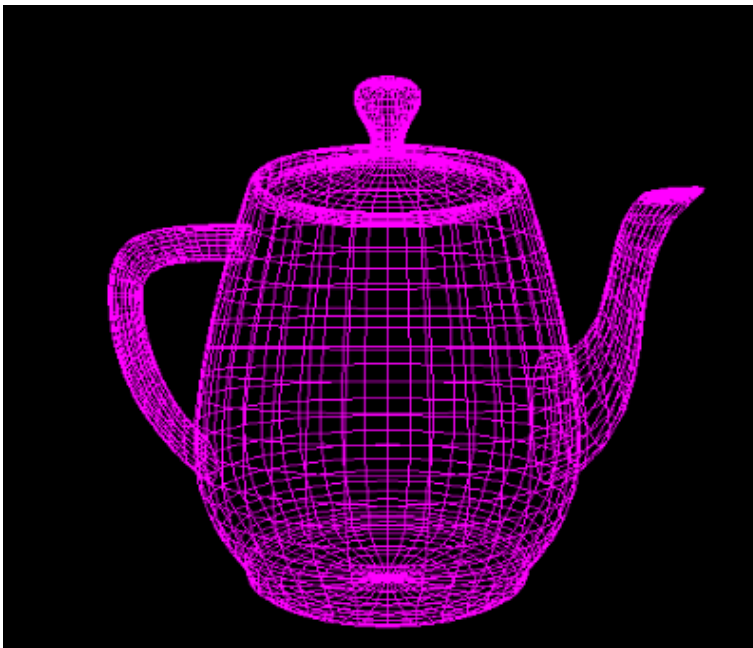
- b) Demonstrate the difference between the following lighting model components and provide the general syntax for setting their RGB default values. (6mks)
 - i) Diffuse
 - ii) Ambient
 - iii) Specular

- c) Aloo came across the graphic below in the course of his studies and wondered what program could have been used to generate it. Write out the program that can be used to generate and render the graphic on the screen. (8 marks)



Question Four: (20 marks)

- a) Write a complete OpenGL program that can be used to render the graphic below on the screen. (12mks)



- b) 3-Dimensional (3D) computer graphics are graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 3D images. Briefly explain each of the following terms as used in 3D graphic models. (8mks)

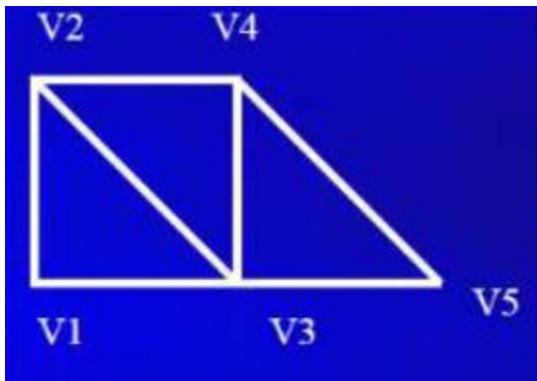
- i) Ray tracing
- ii) Rendering
- iii) Texture mapping
- iv) Pixel-value

Question Five: (20 marks)

- a) A key feature of the design of OpenGL is the separation of interaction (input and windowing functions) from rendering. Briefly explain the two libraries that are used to extend the low-level functionality of OpenGL. (4mks)
- b) Explain the function of each of the following OpenGL functions as used for drawing primitives (4mks)

- i) `glBegin(mode);`
- ii) `glColor3f(1,0,0);`
- iii) `glVertex3f(0,1.5, -2);`
- iv) `glEnd(void);`

- c) Write a program code snippet that generates a GL triangle strip such as one shown below. (6mks)



- d) When you build geometry out of triangles, you don't have to worry about planarity or convexity, since every triangle is both planar and convex. Using relevant diagrams describe the purpose of each of the following geometric primitives as used in rendering triangles in OpenGL. (6mks)
- i) `GL_TRIANGLES`
 - ii) `GL_TRIANGLE_STRIP`
 - iii) `GL_TRIANGLE_FAN`